

# Hospitals need reliable power— application for microturbines?

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by Jan Berry, R&D Program Manager,  
Combined Heating and Power Group  
Oak Ridge National Laboratory

Blackout: power problems taxed electric grid  
means trouble spreads quickly



Importance of distributed  
generation and CHP is  
obvious

# Blackout: Lessons Learned

- Hospitals designed to minimum standards
  - Hill Burton Act: modernize hospitals in disrepair due to depression & WWII
- Infection Control – negative & positive
- Cooling/dehumidification/ventilation
- Hospitals need integrated energy supply systems:
  - NFPA Codes can support on-site energy supply (see handout)

# Blackout did not affect South Oaks Hospital, Amityville, NY

- Staff didn't know there was a blackout until the police called. Hospital offered community services to police and fire stations.
- System details:
  - Installed in 1990 for cost savings
  - 2 dual-fuel engines, 1,300 kW provide all electricity
  - 24/7 operation produces steam (15 lb from jacket water, and 100 lb from engine exhaust)
  - Steam used for building heat, hot water, laundry, kitchen, heating and absorption cooling
- “Good maintenance is key to performance,” says Robert Chester, Director of Engineering, “Engines are maintained every 1,000 hours.”

# Advocate South Suburban Hospital —reliability beyond emergency backup

- Snowstorm in Hazel Crest, Illinois left residents without electricity while hospital operated at full capacity.
- System Details:
  - Installed in 1997, \$1.7M
  - Savings of \$200,000/yr
  - 1,050 kW engine generator
  - Recovered heat used for building heat and hot water
  - Direct-fired absorption chiller



“Some equipment, such as MRI units, are unable to operate while on backup generators. With the on-site power generation, we have three levels of security for our patients,” says Lamar Davis, Director of Facilities Management.

# Children's Hospital—utility rate structure guides system operations

- Installed in Philadelphia, Pennsylvania during 1996, expanded in 1998
- Estimated savings of \$240,000/yr or 5% of electric bill
- 4-760 kW natural gas generators provide cogeneration and shave peak electricity demand



"Our electric power contract is based on our load factor, so we save money throughout the year. We get . . . discounts, and we produce kilowatt hours which we don't have to purchase from the power grid," reports Kevin McCarthy, assistant director of facilities operation.

# CHP in Hospitals Today: >200 existing sites, with 470 MW, just 4% market penetration



# Overcoming Barriers to CHP

- Case studies demonstrate economic potential of CHP
- CHP Application Centers increasing CHP visibility at state level especially in Midwest

## **Case Studies Available**

*Advocate South Suburban Hospital*

*Beloit Memorial Hospital*

*Children's Hospital*

*Hospital in Washington State*

*Lake Forest Hospital*

*Little Company of Mary Hospital*

*Northwest Community Hospital*

*Presbyterian Homes*

*Resurrection Hospital*

*St Francis Hospital*

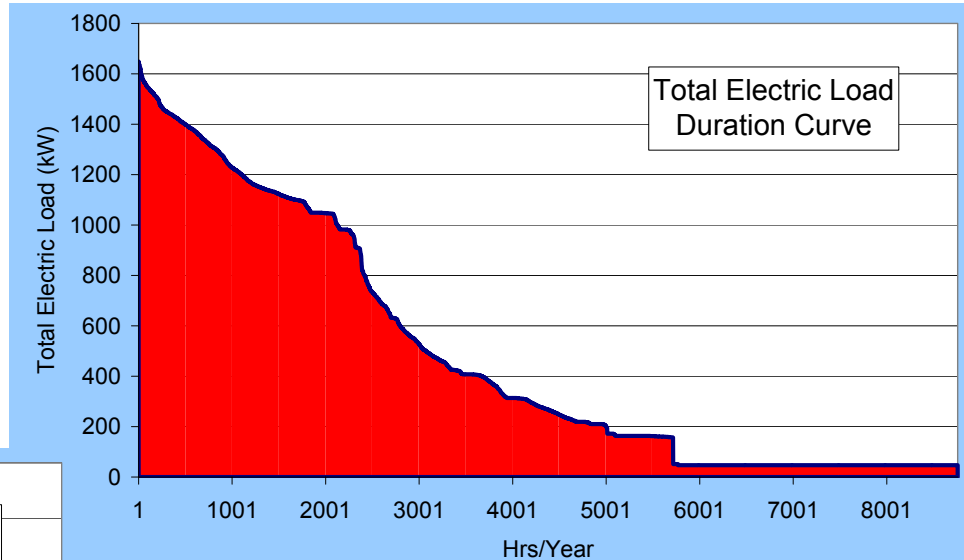
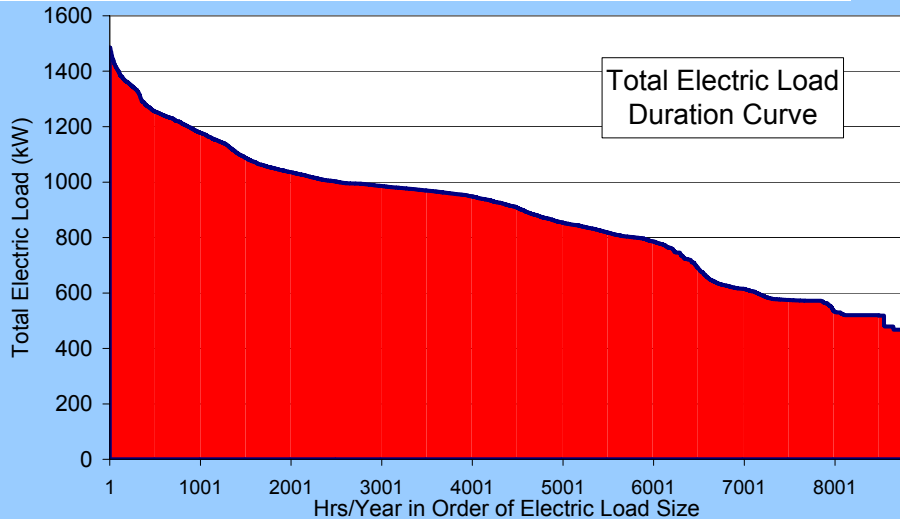
*University of California - Davis Medical Center*

[www.bchp.org/hospitals/](http://www.bchp.org/hospitals/)



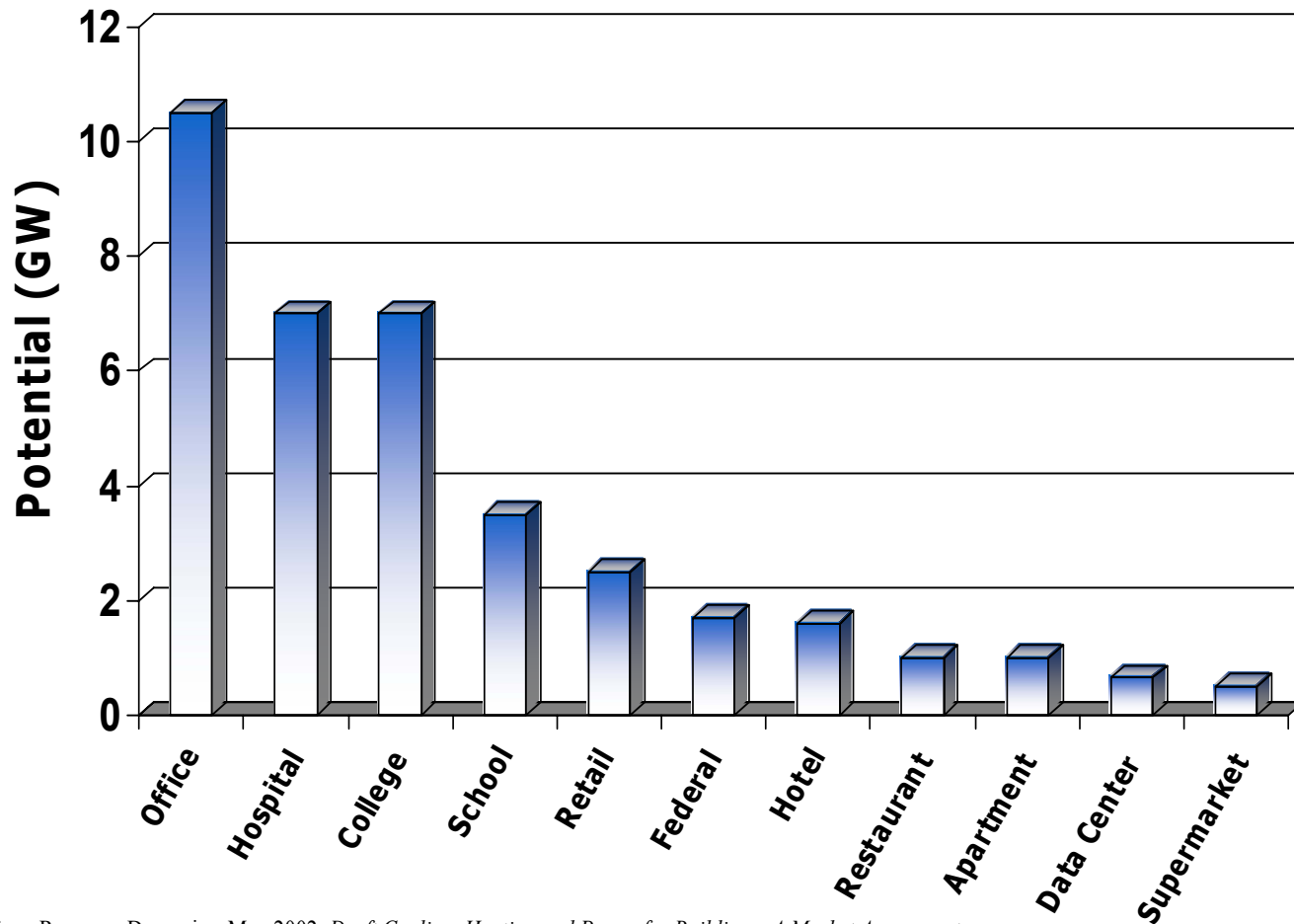
# Hospital Energy Consumption is More Constant than Other Commercial Loads

## Hospital 300,000 SF



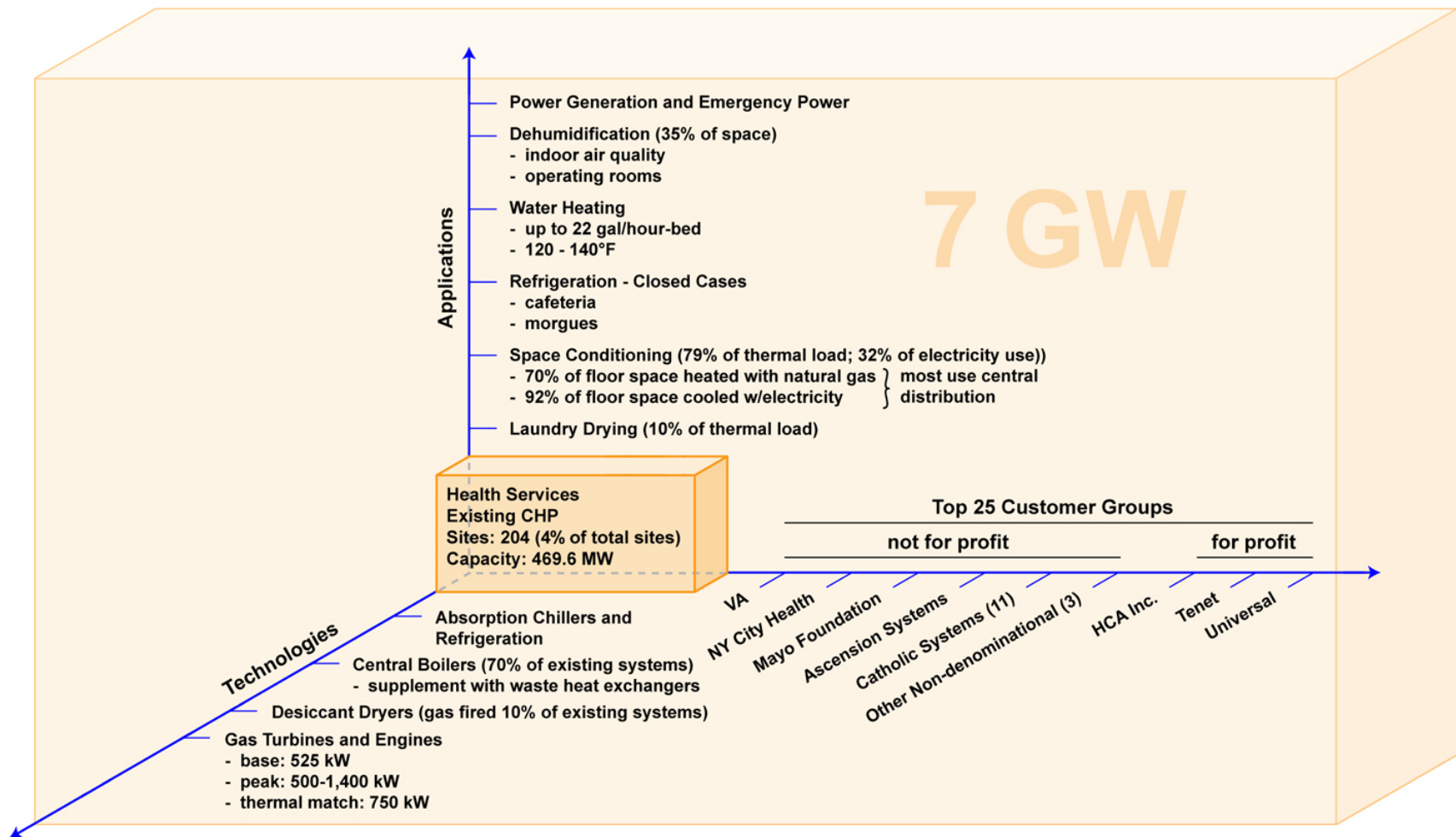
## Office Bldg 300,000 SF

# Hospitals: key CHP market segment



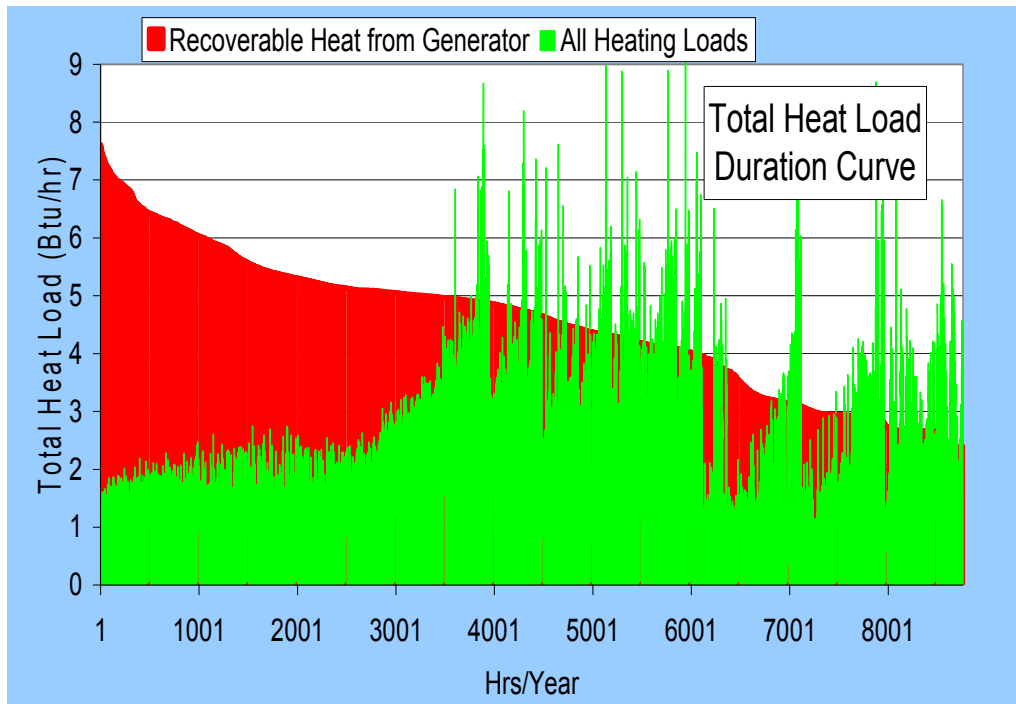
Data from Resource Dynamics, May 2002, *Draft Cooling, Heating and Power for Buildings: A Market Assessment*

# Market Analysis: 7GW of CHP potential, CHP technology matches needs of for-profit/non-profit facilities



Data Source: Energy and Environmental Analysis, Inc.

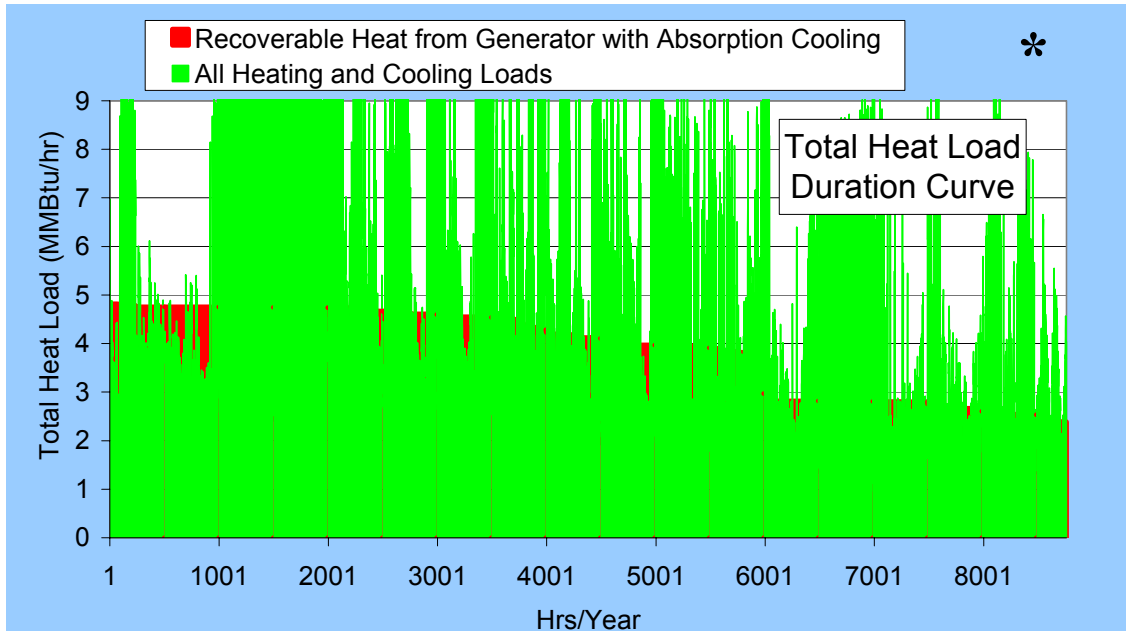
# Hospital CHP: *Improve Power Quality and Reliability*



- Reduce momentary outages
- Provide backup electricity
- Provide backup cooling
- 42% of waste heat for space & water heating

Reference: William Ryan, Ph.D., UIC

# Base-load Hospital CHP: *Optimize Energy Supply*



- Mix electric and absorption chillers to reduce boiler use
- Match heat rejected by generator with a thermal load
- 85% of the Waste Heat Can Be Used for Heating/Cooling
- Peak loads 500-1,400 kW\*\*
- Base load 750kW\*\*

Reference:

\* William Ryan, Ph.D., UIC

\*\* Energy and Environmental Analysis

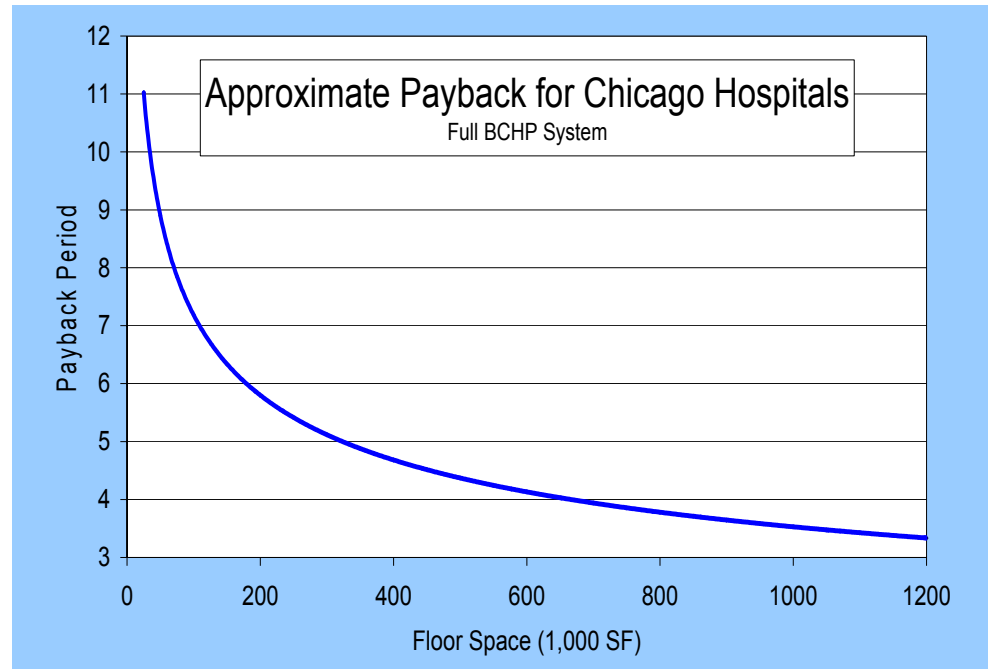
# Develop Business Case for Chief Executives

## ***Reduce energy costs:***

- Cost savings because of improved energy efficiency and reduced momentary outages
- Keep revenue-generating diagnostic equipment operational
- Offer energy flexibility and reduce exposure to energy price volatility

## ***Community Leadership:***

- Improve environmental quality because of higher efficiency energy use



Reference: William Ryan, Ph.D., UIC

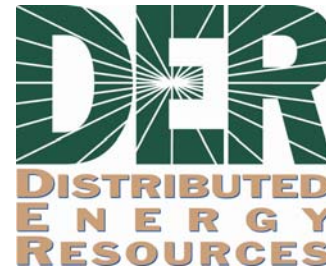
# Active DE/CHP-ASHE Partnership

- Interview and build on experiences of 204 hospitals with CHP
- Analyze data from 150-300 EPA Energy Star Hospital Surveys for potential CHP applications.
- Evaluate AHA construction data base to identify hospitals that are expanding. Encourage capital improvement could include DE/CHP.

**American Society of  
Hospital Engineers**



U.S. Department of Energy  
**Energy Efficiency  
and Renewable Energy**



**OAK RIDGE NATIONAL LABORATORY**

# Hospitals Interested in CHP Installations, but Barriers Exist

## ***Market Drivers***

- Expansion required
  - Under built in 1990's
  - Aging demographics
- New role in community
- 6,000 U.S. hospitals
  - ~0.38 quad/yr of potential savings
- Deregulation introduces uncertainty in long-term project economics

## ***Market Needs***

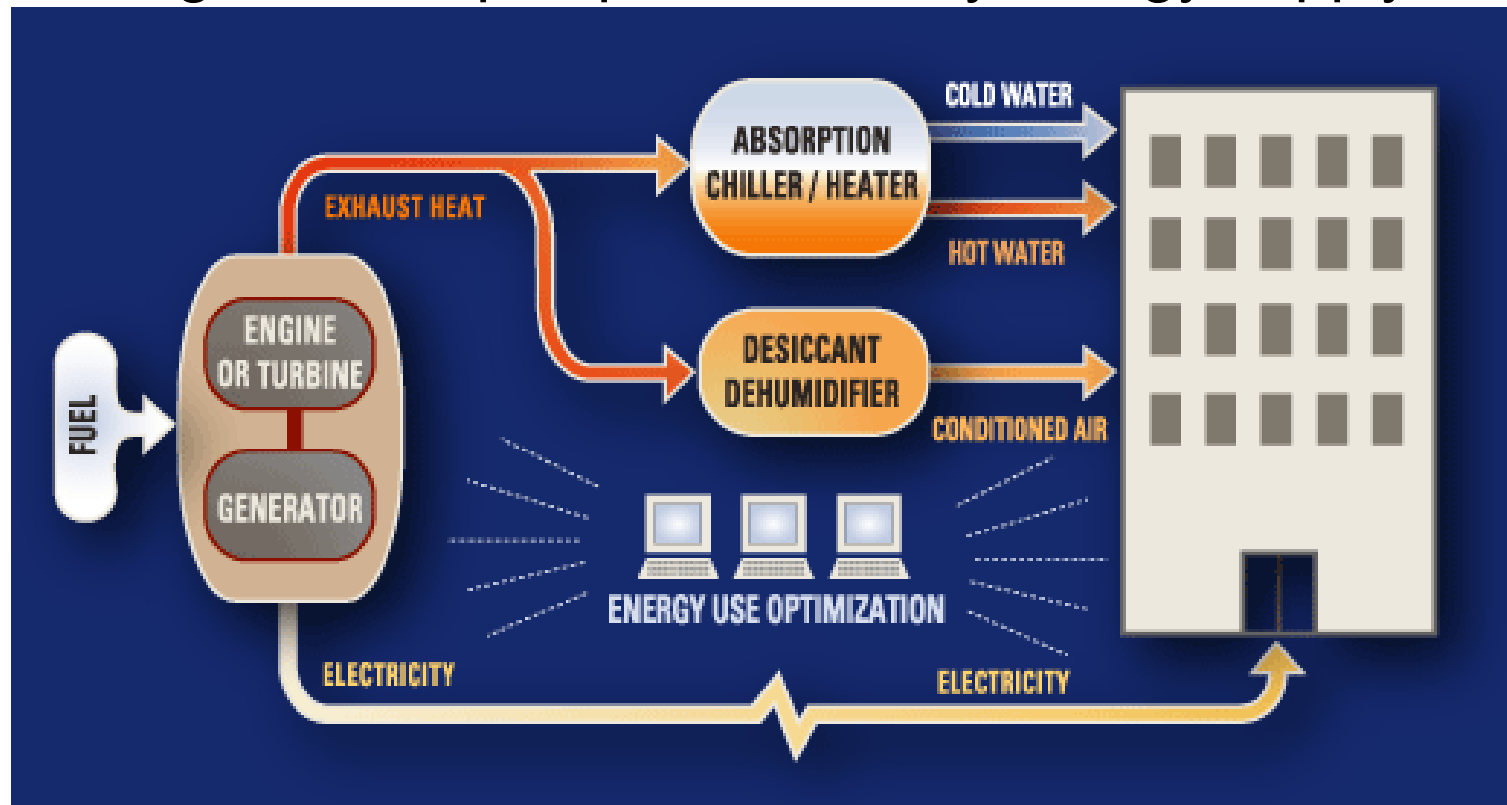
- Knowledge about:
  - CHP benefits especially at executive level
  - Technology advances
- Decisions influenced by:
  - CFO
  - VP of Operations
  - Facility managers
  - Consulting engineers
- Incentives



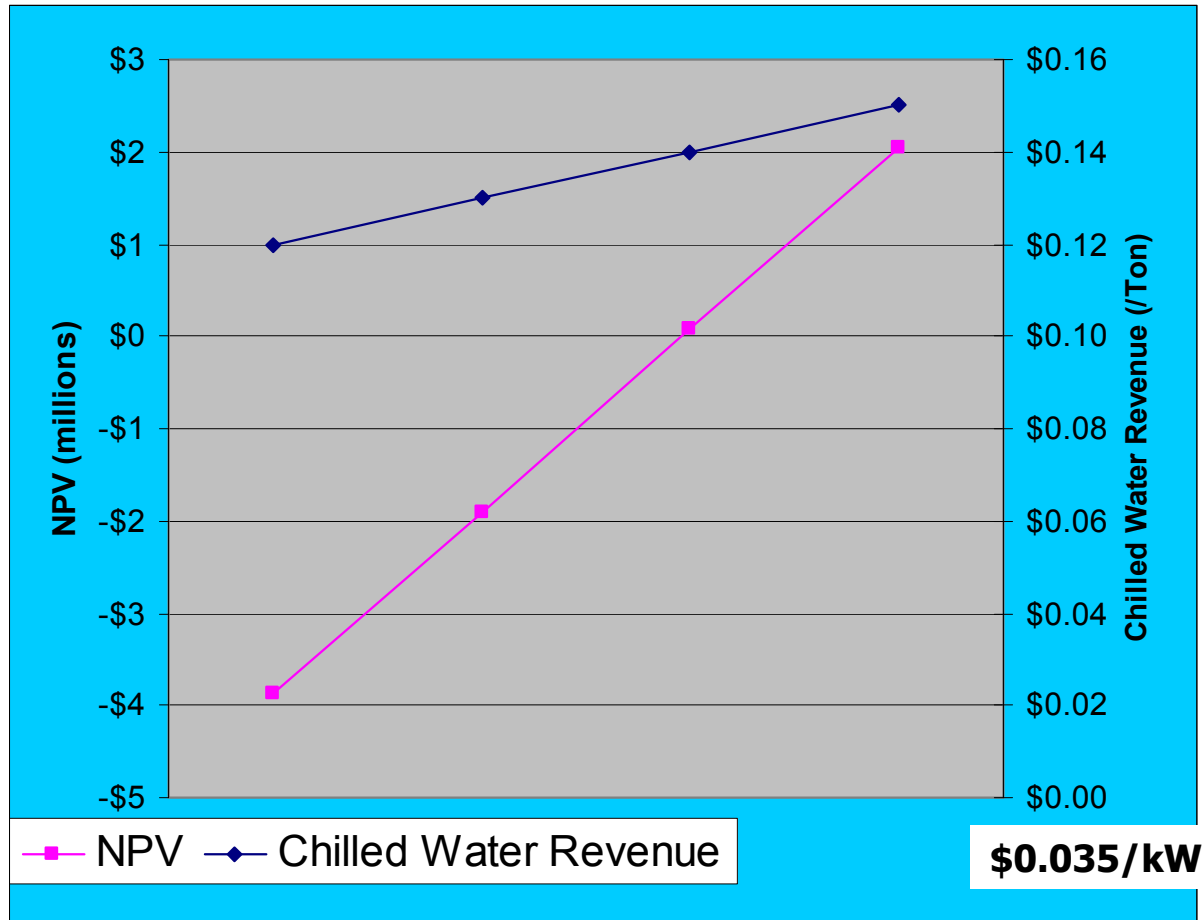
# CHP Tomorrow: Integrated Energy Systems

## Remove Barriers, Improve Products

- Up to 30% lower capital cost
- 1/3 less time and lower cost for installation
- Standardized interfaces
- Integration helps optimize facility energy supply



# Chilled Water Rate Drives Project Economics

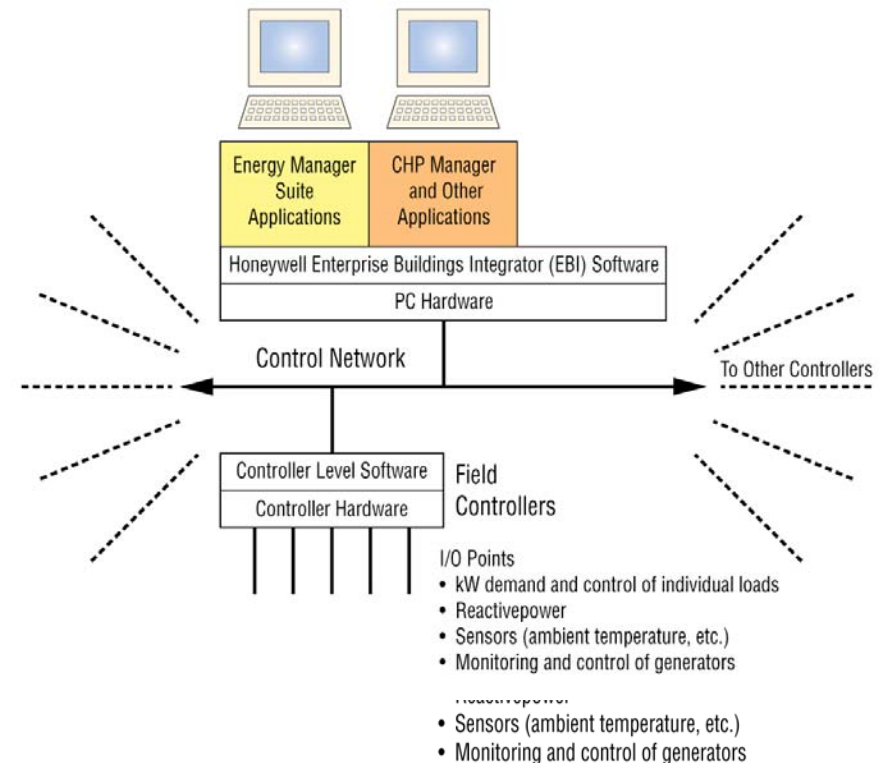


32% of hospital electricity use is for air conditioning  
79% of hospital thermal energy is for HVAC

Source: Clark Energy

# Integrated Energy Systems Advance Systems Controls

- Optimize system performance on:
  - Cost savings,
  - Energy reliability for critical uses
  - Compliance with emissions permit,
- Multiple operating scenarios



## Hospitals—good application for micro-turbines?

- Existing reciprocating engine systems have been successful
- Hospital systems thermal and electric loads match microturbine application
- Partnerships foster interest in hospital market sector

**Background information—not presented during session**

# NFPA and Using CHP to Supplement Emergency Power

Dan Chisholm, Principal  
Motor and Generator Institute

## NFPA 99, 4.4.1.1 On-Site Generator Set

4.4.1.1.1\* Design Considerations. Dual sources of normal power shall be considered but shall not constitute an alternate source of power as described in this chapter.

\*A.4.4.1.1.1 ....Facilities whose normal source of power is supplied by two or more separate central-station-fed services (dual sources of normal power) experience greater reliability than those with only a single feed...

## NFPA 99, 4.4.1.1.4

Essential electrical systems shall have a minimum of two independent sources of power: a normal source generally supplying the entire electrical system and one or more alternative sources for use when the normal source is interrupted.

## NFPA 99, 4.4.1.1.6

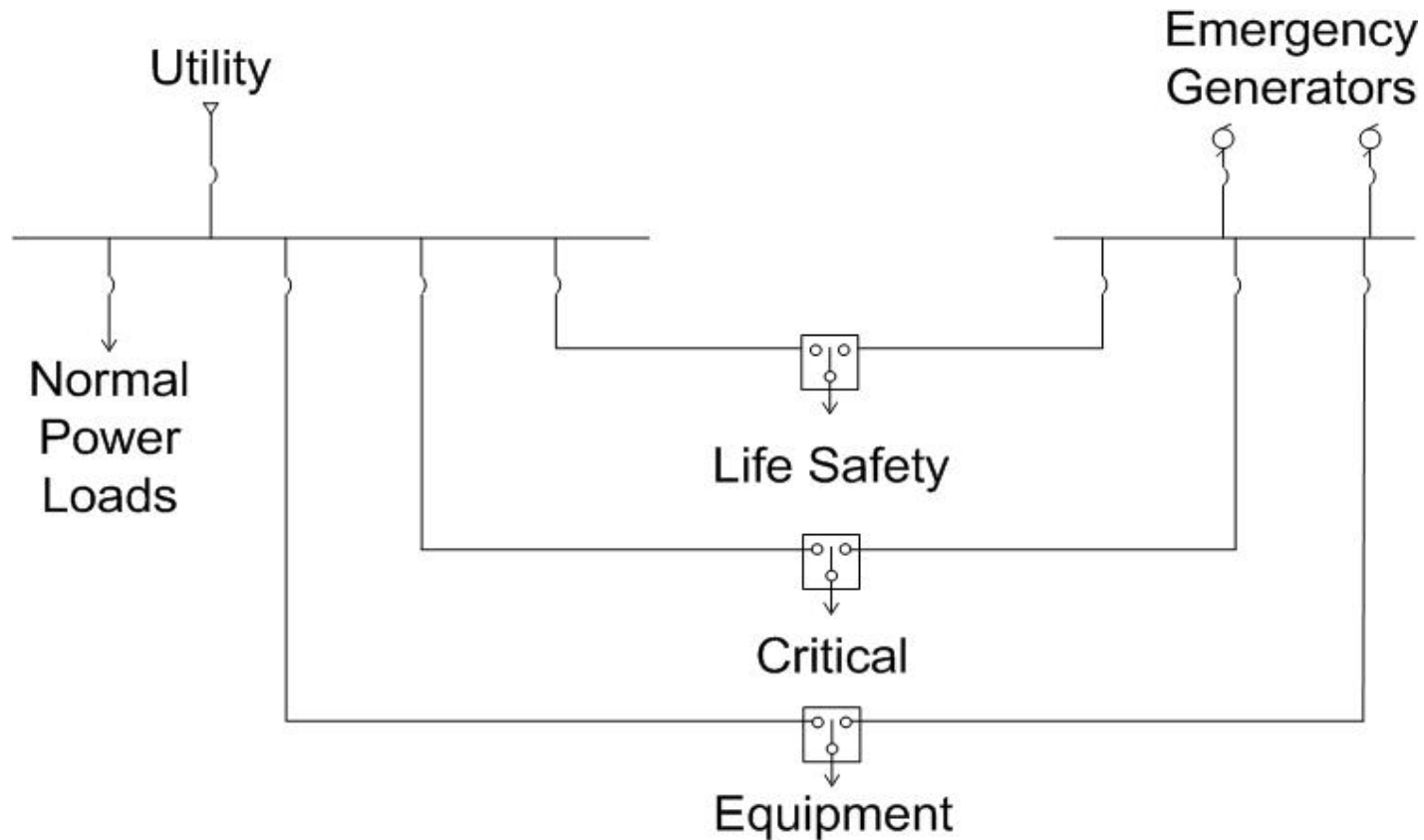
Where the normal source consists of generating units on the premises, the alternate source shall be either another generating set or an external utility service



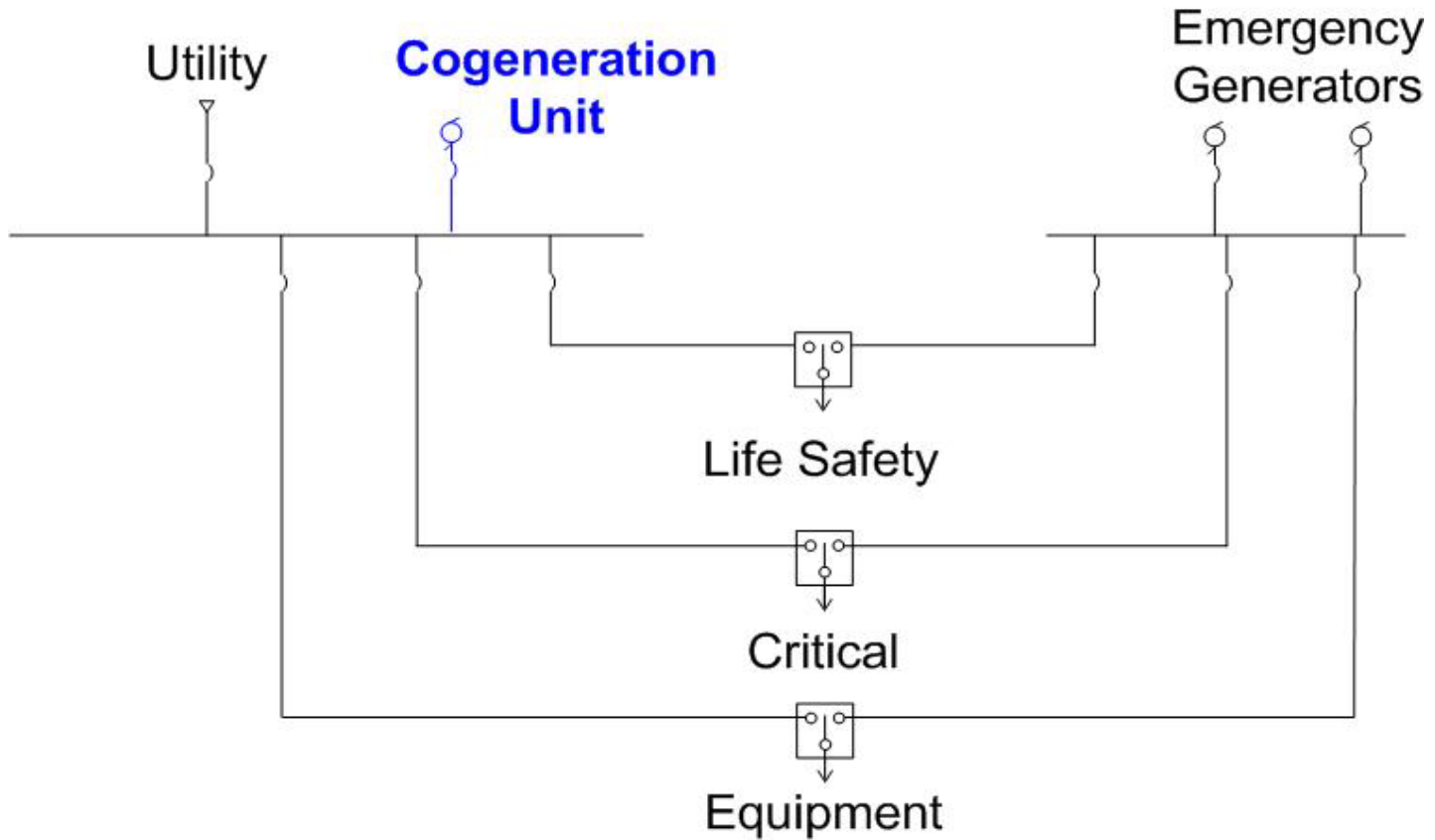
## NFPA 99, 4.4.1.1.8.3

Optional loads *shall be permitted* to be served by the essential electrical system generating equipment. Optional loads *shall be served by their own transfer means* such that these loads shall not be transferred onto the generating equipment if the transfer will overload the generating equipment and *shall be shed* upon a generating equipment overload. Use of the generating equipment to serve optional loads shall not constitute “other purposes” as described in 4.4.1.1.8.1 and therefore *shall not require multiple generator sets*.

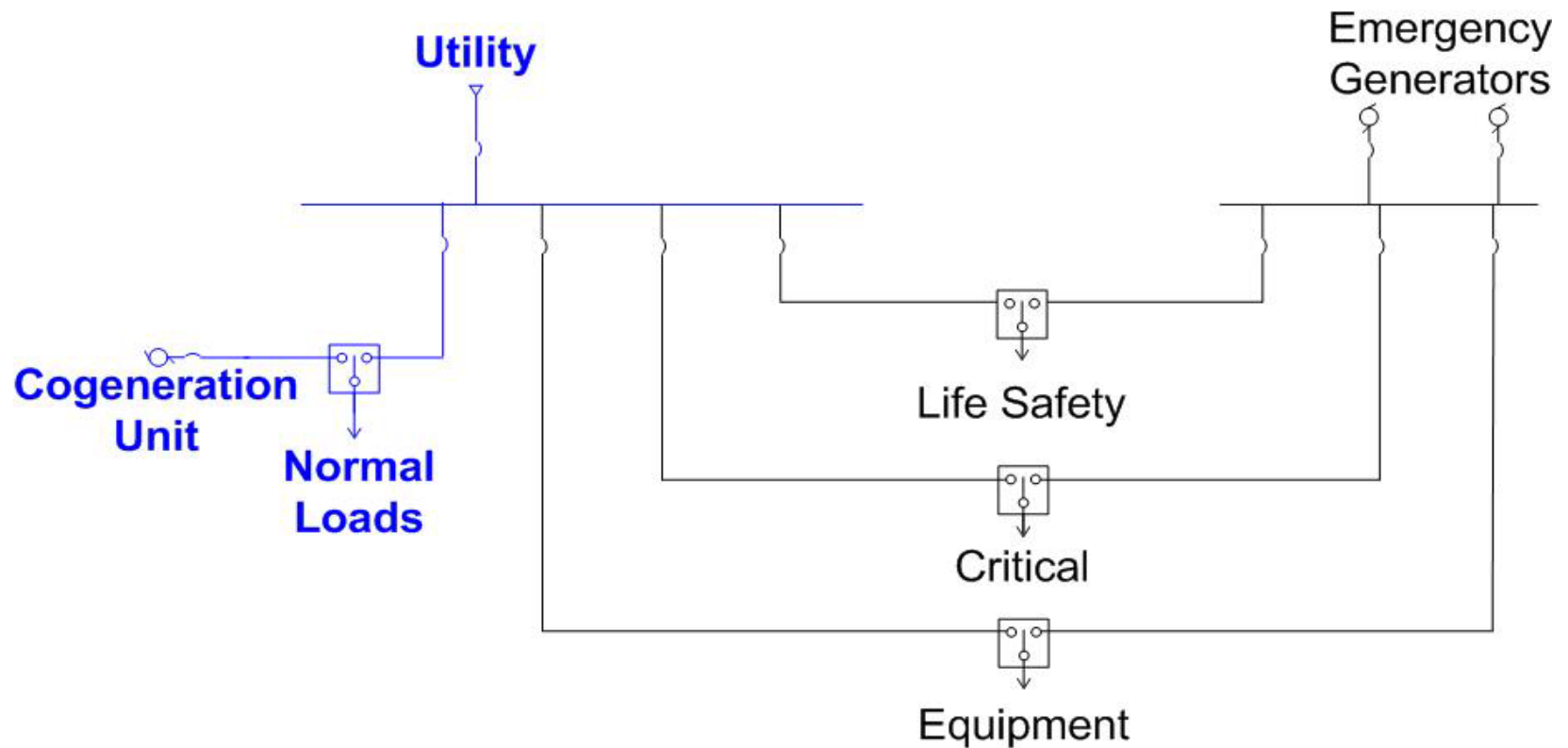
# Healthcare Electrical Distribution System



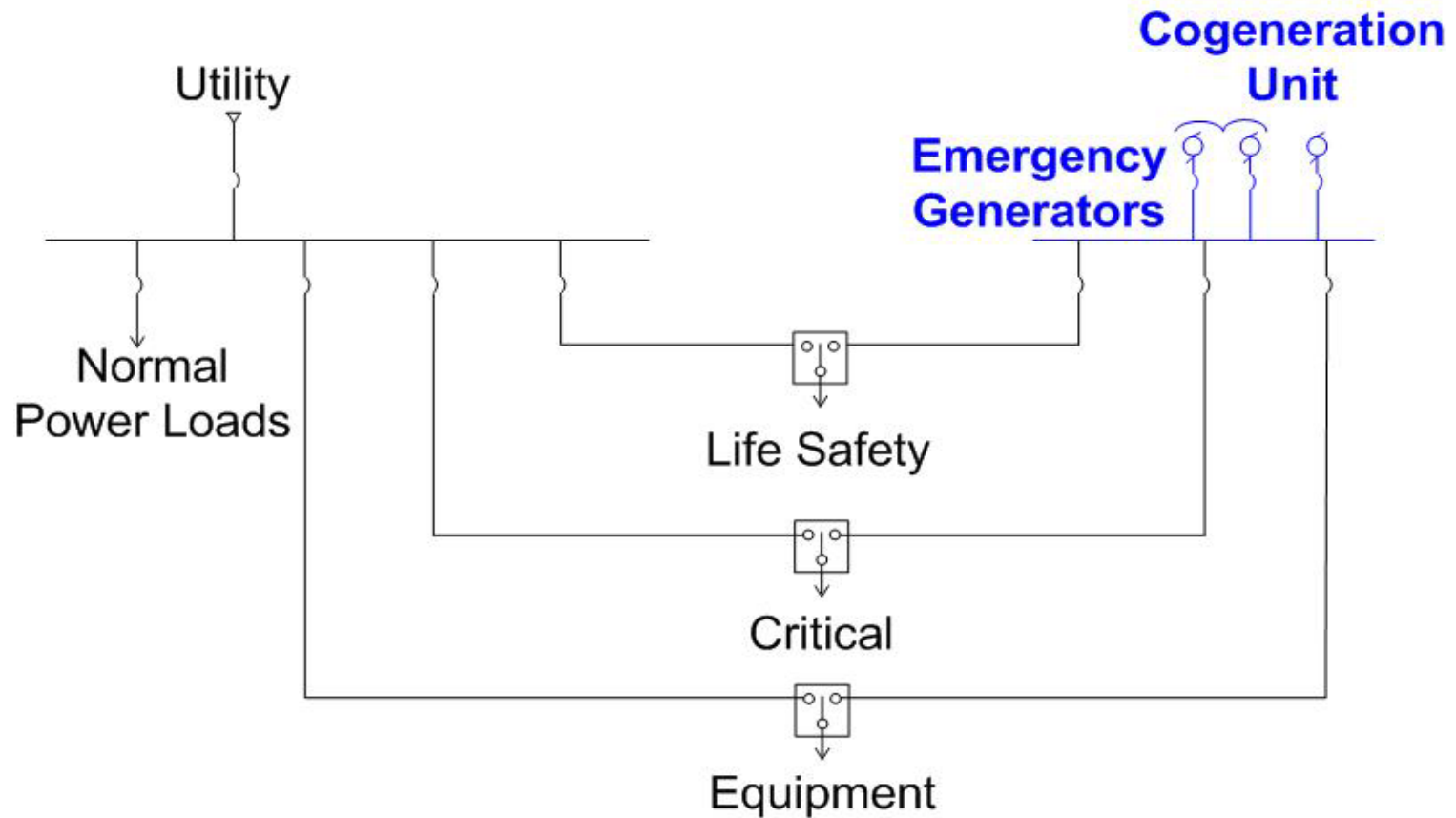
## Option #1 Parallel to Utility



## Option #2 Segregate Normal Loads Via Transfer Switch



## Option #3 Parallel to Emergency Generators



# States Differ



## Option #4 Parallel to Utility and Emergency Generators

